DOCUMENT RESUME

ED 039 709 56 EM 008 042

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TITLE	Dial Access Information Retrieval Systems.
INSTITUTION	Academy for Educational Development, Inc., Washington, D.C.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO	BR-8-0571
PUB DATE	[70]
NOTE	13p.; This is one of the support papers for "To Improve Learning; a Report to the President and the Congress of the United States by the Commission on Instructional Technology", ED 034 905
EDRS PRICE	EDRS Price MF-$0.25 HC-$0.75
DESCRIPTORS	Autoinstructional Aids, Computer Assisted Instruction, *Dial Access Information Systems, Information Retrieval, *Instructional Technology

ABSTRACT

The basic objective of the electronic dial access information retrieval system (DAIRS) is to serve individual students in semi-private listening or viewing situations with a kind of "non-book" library resource almost instantaneously available at the student's option. DAIRS represents the combination of two long established communications techniques--magnetic tape recording and replay devices and telephone dialing switching devices. Only a handful of DAIRS installations offer the random access feature, as the technology for this is both primitive and expensive. Variable video access is also still in the developmental stage. The future will probably bring a combination of the various attributes of a DAIRS system related to multi-branching systems of logic in computer assisted programed instruction. Many schools are already experimenting with one form or another of a DAIRS system, but before the full potential of this or any other technological innovation may be realized a thorough analysis of educational objectives and procedures is in order. (Author/JY)

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DIAL ACCESS INFORMATION RETRIEVAL SYSTEMS

by Richard B. Hull*

An increasing number of schools, colleges and universities are demonstrating interest in electronic dial access information retrieval systems (DAIRS) to support programs of instruction in various subject matter areas. Most present installations provide audio services but some have video capability as well. While equipment suppliers frequently use the term "random access" in describing these systems, only a few such installations now have this desirable capacity. The basic DAIRS objective is to serve individual students in semi-private listening or viewing situations with a kind of "non-book" library resource almost instantaneously available at the student's option.

As a concept, electronic information storage and retrieval is considerably less awesome than it may appear to be although the variety of storage media and technologies now employed or projected for this purpose does comprise a formidable listing.

The mass production of printed books was the first large scale expression of a mechanical storage and retrieval process. Paper was the storage medium, the printing press the recording device, and the human eye was the retrieval mechanism.

Phonographic recording devised early in the 20th Century established the basic principles for all subsequent non-book information storage and retrieval. Sound, transmitted through a microphone was translated into a series of "vibrations" which was physically etched or encoded into "cue" patterns within the circular grooves on a wax or plastic disc. Information, either voice or music, which had been stored on the disc could then be retrieved or decoded by the phonograph needle which retrieved the information by translating the groove

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markings into intelligible "vibrations" which in turn were amplified through a phonograph horn or loud speaker for easier comprehension by the human ear.

While this whole "phonographic" process was soon to become electronic rather than mechanical and would embrace the recording and retrieval of print-out data and television pictures with magnetic plastic tape as the basic storage medium, the essential process has remained unchanged. This concept of transferring or encoding information into a storage medium and retrieving and decoding or translating into a form which the human eye or ear can perceive is applied through a variety of devices to any number of present day applications--business data processing, stereo and video recording and playback, analogue and digital computer systems and, of course, to DAIRS installations.

DAIRS simply represents the combination of two now long established communications techniques--magnetic tape information storage and retrieval and telephone exchange switching. Automated magnetic tape record and replay devices are linked to telephone dialing switching devices which in turn are connected to individual reception points. In some instances a small computer is employed to expedite switching, to control program flow, and to provide a record of DAIRS useage.

Typically a DAIRS installation functions as an electronic non-book library or facility. An assortment of instructional materials pre-recorded on magnetic audio or video tape are collected in a central repository connected to various individual reception points at varying distances from the central facility interconnected by wire or coaxial cable. The interconnections terminate at each reception point in an automatic switching or selection device like those used for dial or "touch-tone" telephones.

A typical user will employ a reference directory or an instructor's assignment sheet to determine the code or dial number of the particular instructional item. When he dials the number, a tape transport (playback) machine at

the library is automatically cued by the dial impulse through a switching system. This selects and sends the requested information to the acoustically treated study booth or carrel from which the "call" originated.

Although these installations have been widely referred to as "random access" systems, until very recently none of them actually had this capability and only a relative handful of DAIRS audio installations (at considerable additional cost) now offer this feature. "Random access" implies that the user can select any information item at will from the repository and hear it or see it relayed to his reception point immediately. In most cases, however, a user actually has only "serial access," i.e., if a given lesson or segment of information already dialed by one user is being transmitted, a second or third dialer seeking that information will "join a program already in progress." Thus the user will have to wait for the tape cycle to end and start again before he can hear the beginning of the lesson.

Theoretically, any desired amount of information on audio and video tape may be stored in a DAIRS library, and any number of reception points established nearby or remote from the library. However, there are both cost and technological limitations (particularly in video systems where the problems can be overwhelming) which enthusiasts may tend to underestimate or overlook.

Indeed, early planners envisioned individual learners throughout a metropolitan area calling into a school or university DAIRS center, using normal residential telephones. Unfortunately, most telephone exchange switching systems are not designed for extended tie-ups of subscriber lines at a single access point as in a DAIRS information bank. Telephone exchanges assume no more than 15 per cent of the subscribers will be using the circuits at one time, but DAIRS users may employ the system 100 per cent of the time. Mass dial-in for the general public through normal telephone exchange facilities is limited to recorded 10-15 second weather and temperature messages, etc. Each DAIRS lesson or informational

playback may run 15 minutes or more, while many different informational packages are playing back at the same time to different users at many reception points. Thus the DAIRS installation must have its own "telephone exchange" or switching system. It must have its own circuits on a campus or within a school system or, if they are leased from a telephone company, must be leased as "dedicated" or sole-use circuits. As sole-use circuits they are not subject to the limitations of the standard telephone exchange.

Equipping a reception point for group rather than for individual carrel listening or viewing is quite feasible where desired. However, the primary concern of educators interested in these systems is not in group instruction but rather in the real or imagined potential which DAIRS has for improving individual and self-study. In some cases the requirements for tapping this potential have not been fully understood especially where video display service has been attempted.

With no known exceptions, DAIRS facilities are used to supplement, not to replace, the teacher in the classroom. Neither is it used as an alternative to required programs of reading and research. Almost any academic discipline may be involved. In school systems lesson materials would typically include English, foreign languages, history, mathematics, science and vocational education. In university applications, DAIRS libraries would include English and the full range of classical and modern foreign languages, various history sequences, education, music, biological and physical science materials. Repository library content varies from school to school and from campus to campus. Useage involves collections of audio materials most of which is locally prepared by faculties who use the DAIRS facilities and correlate them with regular courses of instruction. Use of DAIRS facilities for central video distribution is by comparison sharply limited. Some of the instructional material is prepared locally where

television and film production facilities are available, but much of it is procured on film or tape from outside sources. Surprisingly, little concern has been expressed about copyright and royalty considerations, possibly because so much DAIRS activity is localized and still considered experimental, and perhaps because instructors relate the supplementary materials they prepare so closely with the basic course that they see them as integrated support items rather than separate activities. With any increased use of syndicated materials, however, one may expect this situation to change rapidly.

There are perhaps more than 150 DAIRS installations in school systems and institutions of higher education throughout the country. They vary greatly in size, capability capacity, complexity and cost. A simple audio-only system with limited information storage capacity and 10 or 15 listening posts may be established for $10,000 or less. More elaborate systems, many with video facilities and computerized switching and program equipment and large information storage capacities equipped to serve several hundred listening and viewing posts, call for capital investments of $500,000 or more. However, a true random access audio only DAIRS with 25 individual carrels can call for an investment on the order of $350,000.

In most instances the reception stations, whatever their number, tend to be located in the same building or in buildings near the central library or tape repository. While this self-contained adjacency may be a normal expectation in the first phase of DAIRS installations, because of shorter wire and cable runs and perhaps no more than 150 reception points, other considerations also apply.

A DAIRS installation may also be self-contained because it is considered to be a specialized facility by some administrators. Thus it might be under the aegis of the audio-visual center at a single location in a school system, or regarded as an instructional media laboratory at a College of Education in a university.

When a DAIRS facility is planned as an instructional aid on a university-wide basis, metropolitan area institutions with highly congested campuses may prefer to have all audio-visual instructional aids located in a single building. This central building may be planned as a "learning resource center" equipped with television and radio studios, a graphics department and film department where all instructional materials for DAIRS and other applications are produced. A large centralized facility of this kind conceivably could service 1,000 or more reception terminals. If a video dial access service is involved, centralization of repository and reception stations is logical because much shorter television coaxial cable runs (considerably more expensive than the wired circuits used for audio only facilities) are required.

However, some of the larger university DAIRS installations have adopted a deliberate policy of extending their resources throughout and sometimes out of the campus area. One university facility serves 415 stations, 18 of which have video capability. While the video stations are now immediately adjacent to the tape repository and comprise part of the original central carrel complex of 140 terminals, there are an additional 240 reception stations at various campus locations including the student union building, the library, and various residence halls as well as single reception points at each of 25 fraternity and sorority houses. Plans call for extension of the system to buildings now under construction on a new undergraduate campus. Further extension of the dial access facility services to branch campuses in other cities has been discussed but a decision has been postponed because of costs and technical problems.

Some observers argue that whatever the desired DAIRS service and reception capacity, it should be regarded as a master facility for an institution and housed at a single central point. Expansion of services then would occur, not by the continual addition of diffused reception points, each of which was connected to the master facility, but rather through the establishment of sub-central

DAIRS facilities with adjacent reception stations at various strategic locations throughout a campus. A sub-center might have wire and cable interconnections to the master facility for the purpose of dubbing off master tapes to store in its own tape repository, or it might decide to forego interconnection and physically transport master tape copies instead. The sub-center concept also suggests the possibility of developing specialized tape storage depots keyed to the subject matter of primary concern at a given location.

Technology for audio only DAIRS systems appears to be well advanced, and the basic components for the most part, reliable, provided the purchaser employs competent engineering counsel and understands that equipment dependability is not obtained at bargain prices--either in acquisition of the original equipment or for its continuing maintenance. System designers have now had many years of experience with the basic system elements, automated audio tape recording and playback mechanisms and automated dial select switching systems, in other applications.

A DAIRS installation with many listening stations and the need to provide repository access to as many individuals as possible, may employ a small digital computer control unit to speed up switching; to program segments of repository tapes in different combinations at different times for different reception locations; and to provide a cumulative statistical record of use. Backup computer capacity may also be desirable since these control units are complicated and extremely difficult to repair quickly when problems develop. A faulty computer can bring the entire system to a halt and a system will remain out of operation until the computer is restored and reprogrammed. Use of computer switching, however, should not be regarded as experimental.

DAIRS attempts to provide a viable video dial access retrieval service have been somewhat disappointing since fully adequate technology for this purpose

is still being developed. DAIRS video installations now in operation employ compromise designs which are partly electronic, partly mechanical, and partly manual. The systems, semi-automated at best, are not reliable where continuous high volume use is attempted. Both video tape players and motion picture film projectors feed pictures into the video system. Machines are hand loaded for the most part and cued or switched by hand. Picture quality is below television broadcast standards, the low cost video tape machines employed in these systems were not designed for the kind of heavy work load which continuous useage of the video circuits requires. Even so, the capacity of these installations to distribute pictures exceeds the supply of instructional materials presently available from any combination of sources. A true random access dial capability would further extend that capacity. Some observers believe if user efforts to achieve random or serial video access were abandoned temporarily and the facilities employed to display instructional units on a scheduled basis, some very useful outcomes could be achieved while work on reliable automated video dial access technology continues.

The older more familiar language laboratory, the forerunner of present DAIRS systems, runs the gamut from the simple to the sophisticated. Originally the laboratory merely consisted of collections of disc recordings with examples of the language under study to which an individual student might listen with earphones or a loudspeaker. Later the disc recordings were replaced by magnetic tape recordings. The tape recorder could also be used to record and play back the student's own voice as he practiced phrasing and pronunciation in a study cubicle or carrel, attended from time to time by the supervising language instructor. Subsequently all of these elements were combined through an electronic interconnection and switching system so that the supervising instructor could speak or listen to any individual student; direct the sound from

from pre-recorded language tapes to individuals or to the class as a whole; criticize or compare the student's pronunciation with that on the pre-recorded tape. In addition, the student could record his own pronunciation, compare it with the pre-recorded tapes, or discuss it with the instructor in a live dialogue. Some laboratories have individual tape recorders with delay circuits which permit the student to hear his own words repeated back almost immediately. All of these factors make it possible for the student to work individually at his own pace and to use supplementary resources as desired. Some language laboratories also employ visual aids utilizing slides, motion pictures and video tape materials either in a modified classroom setting or in the study carrels.

At this point, it becomes increasingly difficult to clearly distinguish between a sophisticated language laboratory (which may also have dial access switching capability) and a sophisticated DAIRS system. The study carrel in the DAIRS may incorporate motion picture and television tapes and be employed in language as well as other kinds of instruction. Indeed, many writers in instructional technology use the term "learning laboratory" and "learning resource center" to describe what were formerly regarded as language laboratories but are now employed in the teaching of subjects other than languages.

Those language laboratories which provided individualized instruction and utilized individual study carrels clearly set the pattern for what are now regarded as totally innovative instructional departures characterized by terms such as "auto-tutorial instruction," "audio-tutorial instruction," "auto-didactic instruction," etc. Recent examples of the latter incorporate the familiar carrel now equipped for audio tape recording and playback, motion picture and video tape playback.

A number of the companies who now manufacture and install DAIRS equipment were and are involved in the construction and sale of electronic "language laboratories," "listening centers," and "learning centers," as they are variously termed. Several manufacturers of cross-bar switching and automatic dialing equipment are involved as are some of the major multi-product electronic manufacturers whose equipment offerings run the gamut from television transmitters and studio equipment to microwave systems, tape recording equipment and generating plants.

Singly or in combination with the manufacturers of telephone switching equipment, they are prepared to provide a DAIRS (or "Datagram" as one supplier terms it) installation complete with tape recording and playback gear and radio and television studio facilities for the preparation of software. Many smaller suppliers also provide and install equipment complexes. All of this reflects in part the burgeoning ambitions of industry in the as yet unconsummated marriage of industrial hardware and educational software and still find hopeful expression in the names of some companies such as "Continuous Progress Education," "Omnilab," etc. The implicit promises which the supplier infers and the educational purchasers seem only too willing to believe are even more marked in the nomenclature which the "language laboratory" and "learning laboratory" manufacturers apply to some of their various systems--"The Preceptor," "Transolab," "Electronic Educator," "Select-a-Lesson," "Electronic Learning Center," "Learning Laboratory System," etc.

Assessment of the "real and the imagined" instructional potential in DAIRS and the scores of other electronic "instructional systems" which are literally flooding the market is a formidable task which too few educational purchasers are really qualified to undertake. It is important to find out what these systems are and what they can do--what they are not and what they cannot do.

It would seem to be obvious that an assessment of the educational problem should precede an assessment of electronic systems. A thorough analysis of the educational objectives and step-by-step spelling out of the procedures necessary to attain those objectives are factors which logically should determine the specifications of the "instructional system" which is ultimately selected.

Surprisingly, these analytical procedures are sometimes neglected altogether. An instructional system or an array of electronic devices which purportedly will solve some generally recognized but not carefully specified educational needs of an institution will be acquired. The specific procedures to tap this "educational potential" will actually be devised after the fact. This posture would almost suggest the machine or the system itself is expected to provide elements of the creative function which only its users can supply.

The ongoing search in American education to find more efficient ways of deploying instructional personnel and resources, to individualize instruction and to improve its quality, to keep abreast of the geometric increase in new knowledge, at times takes on almost panic aspects. Compared with business, industry and the military, the educational establishment has been a laggard in developing and employing new ways and means of analyzing, processing, storing, retrieving and distributing information, which is really one of its most basic concerns.

Now, as education without much previous experience in electronic information systems, begins to grope for a kind of "instructional technology" of its own, it sometimes appears to act as if it were "re-inventing the wheel." While the endeavors of education to employ technology for instruction may be unique, the technical requirements and operational principles which information systems employ are not.

Institutions on every instructional level tend to greatly overestimate the actual scope and degree of the educational establishment's present involvement with "instructional technology." Because computers are widely used in processing educational data and in making research computations, some observers infer that a parallel application in computer assisted instruction is underway. Because a carrel designed to foster self-study has usefully employed an audio or video dial access system, enthusiasts rush forward to construct more and separate carrels, each of which is dedicated to a different media application, i.e., motion pictures, teaching machines, a computer terminal, etc., ignoring the fact that the same reception point might embrace all of these facilities.

Often these institutions, feeling they are falling behind in the "instructional technology" process react too readily to the appeals of equipment suppliers and grasp for "instant solutions." They fail to differentiate between the many widely reported experimental projects where outcomes are still to be determined and some of the solid demonstrations of technology applied to educational purpose which have become integral parts of the instructional process.

Obviously, the future will bring a combination of the various attributes of each of these systems related to multi-branching systems of logic in computer assisted programs of instruction. Undoubtedly, the sophisticated libraries of the future will incorporate dial access storage and retrieval information banks with both print out and pictorial reproduction capacity which, on the one hand, will be used by the computer in instructional patterns, and on the other will be available for simple and collated reference purposes as conventional libraries are used today. The future libraries will be disseminators as well as collectors of information.

Over-riding all of the technical factors noted thus far, the major and most important problem is planning and producing the necessary instructional materials at high levels of quality and in sufficient quantity to make DAIRS or any of the related or comparable systems truly effective teaching instruments. Electronics firms and photographic equipment manufacturers are purchasing textbook publishing companies in the hope that effective programmed sequences for machine instruction will emerge. General Sarnoff explained RCA's merger with Random House by saying, "They have the software and we have the hardware." FORTUNE magazine, along with many other observers, responded by saying "as far as education is concerned, neither side has it yet."